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Code No: 127FE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech IV Year I Semester Examinations, February - 2025

MICROWAVE ENGINEERING

(Electronics and Communication Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a)	Define phase velocity and group velocity of a wave.	[2]
b)	Draw the field pattern of TE_{11} mode in rectangular waveguide.	[3]
c)	Find the resonant frequency of an air-filled cavity resonator with dimensions. a=5 cm,b=3=cm and d=4 cm.	[2]
d)	Draw the E-plane Tee junction diagram.	[3]
e)	What is transit time effect in conventional tubes?	[2]
f)	Draw typical Applegate diagram.	[3]
g)	What is mode jumping in cavity magnetron?	[2]
h)	Draw the diagram of IMPATT diode and carrier concentration.	[3]
i)	State the significance of S-Parameters at high frequencies.	[2]
j)	What are the possible errors in high frequency measurements?	[3]

PART – B

(50 Marks)

2.a)	Why TEM modes are not possible in hollow rectangular wave guides? Elaborate.	
b)	A TE_{10} wave at 10 GHZ propagates in a rectangular wave guide filled with medium air has dimensions 1.5 cm X 0.6 cm. Determine guided wave length and wave impedance.	[4+6]
	OR	
3.	Derive the expressions for the field components due to TE waves in a rectangular waveguide.	[10]
4.a)	Describe the working of H-plane Tee and state why it is called shunt Tee.	
b)	With the help of diagram, explain working of Gyrator.	[5+5]
	OR	
5.a)	Discuss how mods are created on a rectangular cavity.	
b)	Explain the working of Magic Tee with neat sketch.	[5+5]

6.a) With the help of Applegate diagram, explain the bunching process and hence the velocity modulation in Klystron amplifier.

b) State the limitations of conventional tubes at high frequencies. [7+3]

OR

7.a) Classify the various microwave tubes with respect to the orientation of electric and magnetic fields.

b) Explain with neat sketch, the principle of operation of a TWT amplifier and write the equations for the maximum voltage gain and efficiency. [4+6]

8.a) Derive equation for Hull cut-off voltage in a Magnetron.

b) Explain the principle of operation of cavity magnetron and discuss phase focusing effect. [5+5]

OR

9.a) Discuss in detail the principle of operation of GUNN diode considering the two valley model theory and sketch its volt-ampere characteristics.

b) An n-type GaAs GUNN diode has the following specifications:

Threshold field	3kV/cm
Applied field	3.0 kV/cm
Device length	9 micrometers
Doping constant	10^{14} electrons/cm^3
Operating frequency	10 GHz

Calculate the current density (-ve) and electron mobility in the device. [5+5]

10.a) Derive the s-matrix of circulator.

b) Explain the double minima method of measuring VSWR. [5+5]

OR

11.a) Describe how the frequency of a given microwave source can be measured using two different methods.

b) What are the different possible errors that will affect VSWR measurements? [7+3]

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